IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	DEORE, Bhavana A. et al
Serial Number:	10/581,752
Filed:	12/20/2006
Title:	A SWITCHABLE SELF-DOPED POLYANILINE
Group Art Unit:	1766
Examiner:	FANG, Shane
Attorney Docket:	17522NP (84827-3)
Conformation:	8507

February 16, 2011

Honorable Commissioner for Patents
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE TO FINAL OFFICE ACTION

Dear Sir,

This is in response to the Office Action dated Office Action dated August 17, 2010 for which the three (3) month term for response expired November 17, 2010. Please find attached a Petition for a three (3) month extension of time and a Request for Continued Examination.

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this response; and

Remarks/Arguments begin on page 8 of this response.

AMENDMENTS TO THE CLAIMS

Without prejudice, please amend the claims as reflected in the following listing of claims, whichl replaces all prior versions, and listings, of claims in this application:

Listing of Claims:

1.(Currently Amended) A conductive boronic acid substituted polyaniline polymer capable of converting in solution between a water-soluble self-doped form and a water-insoluble non-self doped form, wherein conversion between the water-insoluble non-self-doped form and the water-soluble self-doped form is by a reversible chemical reaction ~~wherein the reversible chemical reaction~~ that comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride, and wherein the polyaniline polymer has a molecular weight of at least 100,000.

2.(Currently Amended) The polyaniline polymer according to claim 1, wherein a dried film of the self-doped polymer has ~~having~~ a hardness of at least 0.03 GPa.

3. (Canceled)

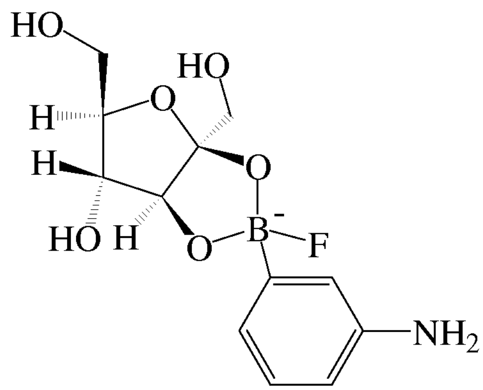
4. (Canceled)

5. (Canceled)

6. (Currently Amended) A ~~self-doped~~ polyaniline polymer capable of converting in

solution between:

a water-soluble self-doped form comprising repeating units as shown below:



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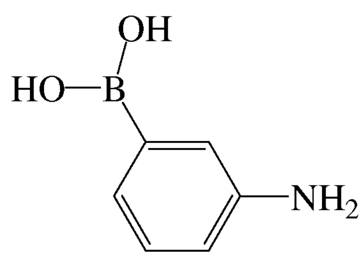
; and

a water-insoluble non-self-doped form comprising repeating units as shown below:



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wherein the polyaniline polymer has a molecular weight of at least 100,000, and wherein the water-soluble form is converted in solution to the water-insoluble form by reducing fluoride and/or fructose concentration of the polymer solution and the water-insoluble form is converted to the water-soluble form by increasing fluoride and/or fructose concentration of the polymer solution.

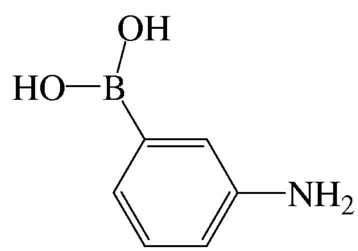
7. (Currently Amended) The polyaniline polymer according to claim 6, wherein a dried film of the self-doped polymer has ~~having~~ a hardness of at least 0.03 GPa.

8. (Canceled)

9. (Canceled)

10. (Withdrawn) A method of making a self-doped polyaniline comprising:

(a) providing a monomer:



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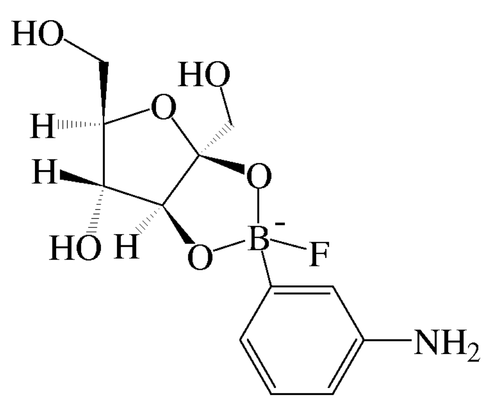
, D-fructose and fluoride;

(b) incubating said monomer, the D-fructose and the fluoride under conditions suitable for polymerization, thereby producing a first polymer:



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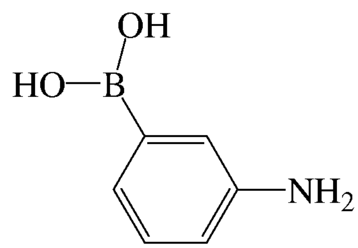
(c) precipitating said polymer by reducing the fluoride concentration, thereby producing a second polymer:



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11. (Withdrawn) The method according to claim 10 including:

(d) heating the second polymer, thereby forming a cross-linked polymer.

12. (Withdrawn) The method according to claim 10 having a hardness of at least 0.03 GPa.

13. (Withdrawn) The method according to claim 10 having a molecular weight of at least 10,000.

14. (Withdrawn) The method according to claim 10 having a molecular weight of at least 100,000.

15. (Currently Amended) The polyaniline polymer according to claim 1 wherein the saccharide is D-fructose.

16. (Currently Amended) The polyaniline polymer according to claim 1, wherein a dried film of the self-doped polymer has ~~having~~ a hardness of at least 0.03 to 0.5 GPa.

17. (Currently Amended) The polyaniline polymer according to claim 1, wherein a dried film of the self-doped polymer has ~~having~~ a hardness of at least 0.04 to 0.5 GPa.

18. (Currently Amended) The polyaniline polymer according to claim 1, wherein a dried film of the self-doped polymer has ~~having~~ a hardness of at least 0.05 to 0.5 GPa.

19. (Currently Amended) The polyaniline polymer according to claim 1, wherein a dried film of the self-doped polymer has ~~having~~ a hardness of at least 0.06 to 0.5 GPa.

20. (Currently Amended) The polyaniline polymer according to claim 1 having a molecular weight of at least 100,000 to 2,000,000.

21. (Currently Amended) The polyaniline polymer according to claim 6, wherein a dried film of the self-doped polymer has ~~having~~ a hardness of at least 0.03 to 0.5 GPa.

22. (Currently Amended) The polyaniline polymer according to claim 6, wherein a dried film of the self-doped polymer has ~~having~~ a hardness of at least 0.04 to 0.5 GPa.

23. (Currently Amended) The polyaniline polymer according to claim 6, wherein a dried film of the self-doped polymer has ~~having~~ a hardness of at least 0.05 to 0.5 GPa.

24. (Currently Amended) The polyaniline polymer according to claim 6, wherein a dried film of the self-doped polymer has ~~having~~ a hardness of at least 0.06 to 0.5 GPa.

25. (Canceled)

26. (Currently Amended) The polyaniline polymer according to claim 6 having a molecular weight of at least 100,000 to 2,000,000.

27. (New) The polyaniline polymer according to claim 20, wherein a dried film of the self-doped polymer has a hardness of at least 0.03 to 0.5 GPa.

28. (New) The polyaniline polymer according to claim 26, wherein a dried film of the self-doped polymer has a hardness of at least 0.03 to 0.5 GPa.

REMARKS/ARGUMENTS

Claims 1-2, 6-7, 15-24, and 26 have been amended. Without prejudice, Claims 3, 4, 8, 9, and 25 have been canceled. New Claims 27 and 28 have been added. Support for the amendments and new claims can be found throughout the Specification and Figures. No new matter has been added.

Claims 1-2, 6-7, 15-24, and 26-28 are now pending.

Reconsideration of the application in view of the above amendments and the following remarks is respectfully requested.

Nonstatutory Double Patenting Rejection based on Co-pending Application No. 12/161,235

The Examiner provisionally rejected Claims 1-2, 15-19 and 21-24 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over Claims 1-12 of co-pending Application No. 12/161,235 (the "co-pending Application"). Applicants note that independent Claim 1 has been amended to recite the feature that the polyaniline polymer has a molecular weight of at least 100,000, as recited in Claim 4 now canceled. Applicants note that independent Claim 6 has been amended to recite the feature that the polyaniline polymer has a molecular weight of at least 100,000, as recited in Claim 9 now canceled. Claims 4 and 9 were not rejected on the ground of nonstatutory obviousness-type double patenting, and accordingly, Applicants submit that the amendments to Claims 1 and 6 address the Examiner's provisional nonstatutory obviousness-type double patenting rejection of these claims. Claims 2, 15-19 and 21-24 depend directly on Claim 1 or 6. Accordingly, withdrawal of the rejection of Claims 1-2, 15-19 and 21-24 based on Claims 1-12 of the co-pending Application is respectfully requested.

Rejection Under 35 U.S.C. § 102(b) based on Shoji et al.

The Examiner rejected Claims 1-2, 6-7, 15-19, and 21-24 as being anticipated by Shoji et al. (JACS 2002, 124, 12486-12493). Applicants note that independent Claims 1 and 6 have been amended to recite the feature that the polyaniline polymer has a molecular weight of at least 100,000, as recited in now canceled Claims 4 and 9, respectively. Claims 4 and 9 were not rejected as being anticipated by Shoji et al., and accordingly, Applicants submit that amended Claims 1 and 6 are not anticipated by Shoji et al. and request withdrawal of the rejection of Claims 1 and 6 based on Shoji et al. Claims 2, 7, 15-19, and 21-24 depend directly on Claim 1 or 6. Accordingly, withdrawal of the rejection of Claims 2, 7, 15-19, and 21-24 based on Shoji et al. is respectfully requested.

Rejection Under 35 U.S.C. § 102(b) based on Freund et al.

The Examiner rejected Claims 1-2, 6-7, 15-19, and 21-24 as being anticipated by Freund et al. (US 2002/0029979). Applicants note that independent Claims 1 and 6 have been amended to recite the feature that the polyaniline polymer has a molecular weight of at least 100,000, as recited in now canceled Claims 4 and 9, respectively. Claims 4 and 9 were not rejected as being anticipated by Freund et al., and accordingly, Applicants submit that amended Claims 1 and 6 are not anticipated by Freund et al. and request withdrawal of the rejection of Claims 1 and 6 based on Freund et al. Claims 2, 7, 15-19, and 21-24 depend directly on Claim 1 or 6. Accordingly, withdrawal of the rejection of Claims 2, 7, 15-19, and 21-24 based on Freund et al. is respectfully requested.

Rejection Under 35 U.S.C. § 103(a) based on Shoji et al. in view of Mattoso et al.

The Examiner rejected Claims 3-4, 8-9, 20, and 25-26 as being unpatentable over Shoji et al. (JACS 2002, 124, 12486-42493) in view of Mattoso et al. (Synthetic Metals, 68 (1994), 1-11). Applicants note that Claims 3, 4, 8, 9, and 25 have been canceled. This renders moot the Examiner's rejection of Claims 3, 4, 8, 9, and 25 based on Shoji et al. in view of Mattoso et al. Applicants respectfully submit that Claims 20 and 26 are not

unpatentable over Shoji et al. in view of Mattoso et al. for the reasons set out below.

Applicants submit that the Shoji et al. and Mattoso et al. references fail to satisfy the requirements for a finding of obviousness of amended independent Claim 1 and amended independent Claim 6.

Applicants' submissions in this respect have been prepared in light of the "Examination Guidelines for Determining Obviousness Under 35 U.S.C. § 103 in view of the Supreme Court Decision in *KSR International Co. v. Teleflex Inc.*" (Federal Register, Vol. 72, No. 195, Oct. 10, 2007, pp. 57526 – 57535) (the "Guidelines").

In *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 at 17-18 (1966), the Supreme Court set out the following objective framework for applying the statutory language of §103:

> Under §103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.

Accordingly, the Guidelines confirm that obviousness is a question of law based on underlying factual inquiries. The factual inquiries enunciated by the Court in *Graham* are as follows:

(1) Determining the scope and content of the prior art;

(2) Ascertaining the differences between the claimed invention and the prior art; and

(3) Resolving the level of ordinary skill in the pertinent art.

With respect to the second of the *Graham* factual inquiries, Applicants submit that

important differences exist between the claimed invention and the Shoji et al. and Mattoso et al. references.

Amended Claim 1 recites: A conductive boronic acid substituted polyaniline polymer capable of converting in solution between a water-soluble self-doped form and a water-insoluble non-self doped form, wherein conversion between the water-insoluble non-self-doped form and the water-soluble self-doped form is by a reversible chemical reaction that comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride, and wherein the polyaniline polymer has a molecular weight of at least 100,000.

Applicants submit that Shoji et al. does not teach or suggest a boronic acid substituted polyaniline polymer capable of converting in solution between a water-soluble self-doped form and a water-insoluble non-self doped form. In addition, Shoji et al. does not teach or suggest that conversion is by a reversible chemical reaction that comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride. Shoji et al. also does not teach or suggest that the boronic acid substituted polyaniline polymer has a molecular weight of at least 100,000.

Applicants submit that Mattoso et al. does not teach or suggest a boronic acid substituted polyaniline polymer capable of converting in solution between a water-soluble self-doped form and a water-insoluble non-self doped form. In addition, Mattoso et al. does not teach or suggest that conversion is by a reversible chemical reaction that comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride. Mattoso et al. also does not teach or suggest that the boronic acid substituted polyaniline polymer has a molecular weight of at least 100,000.

On pages 7-8 of the Final Action, the Examiner states as follows:

> Mattoso et al. discloses increasing the MW to 64-90k of polyanilines by successive oxidation and further increasing the MW to 156k or 160k by using polyvinylsulfonic acid or ammonium peroxydisulfate for oxidative polymerization (Pg. 1, col. 1-2). Mattoso et al. teaches having high MW is highly desirable (Pg. 1, col. 1).

> One of ordinary skill in the art would obviously recognize to increase MW of a polymer for improving its film forming capability and mechanical strength.

On page 8 of the Final Action, the Examiner further states:

> ...it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the polyaniline disclosed by Shoji et al. and increased MW to the claimed ranges in view of Mattoso et al., because the resultant higher MW polyaniline would yield improved film forming capability and mechanical strength.

Applicants submit that it would not have been obvious to one of ordinary skill in the art to have modified the polyaniline disclosed by Shoji et al. and increased MW to the claimed ranges in view of Mattoso et al. because Mattoso et al. does not teach or suggest how Shoji et al. might be modified to prepare the boronic acid substituted polyaniline polymer capable of converting in solution between a water-soluble self-doped form and a water-insoluble non-self doped form that has a molecular weight of at least 100,000, as recited in amended Claim 1. There is no reasonable probability of success in preparing the boronic acid substituted polyaniline polymer of Claim 1 based on Shoji et al. in view of Mattoso et al.

For example, Mattoso et al. does not describe the preparation of a <u>boronic acid substituted</u> polyaniline polymer as recited in Claim 1. In contrast, Mattoso et al. describes the preparation of polyaniline and poly(*o*-methoxyaniline). Mattoso et al. recites as follows on page 8:

> The present study has brought to light a remarkable dependence of the molecular weight of <u>polyaniline</u> and of <u>poly(*o*-methoxyaniline)</u> during the oxidative polymerization of aniline and of methoxyaniline, respectively, at 0 to 3 °C in the presence of neutral metallic salts. **[emphasis added]**

Furthermore, neither Shoji et al. nor Mattoso et al. teach or suggest the polymerization of boronic acid substituted polyaniline in the presence of both a saccharide and fluoride. Use of both a saccharide and fluoride during polymerization allows for the preparation of boronic acid substituted polyaniline having a molecular weight of at least

100,000. On page 11 of the Final Action, the Examiner states as follows:

> One of Mottoso's objectives is to increase the MW via using polyvinylsulfonic acid or ammonium peroxydisulfate for oxidative polymerization, and using LiF, NaCl, $CaCl_2$, and $LiNO_3$ increases the MW of polymer produced.

Applicants respectfully disagree with the Examiner's interpretation of Mattoso et al. that using LiF increases the MW of polymer produced. In contrast, using LiF did not increase the MW of the polymer produced as described in Mattoso et al. For example, Mattoso et al. states as follows on page 8:

> The presence of LiCl, NaCl, $CaCl_2$ and $LiNO_3$ dissolved in the reaction mixture increases the molecular weight of the polymer produced, whereas dissolved LiF and dissolved agar (which increases the viscosity of the reaction solution) both decrease the molecular weight as compared to the polymer obtained when the reaction is carried out in the absence of added neutral salts.
> **[emphasis added]**

Thus, using dissolved LiF decreases the molecular weight [of the polymer produced] as compared to the polymer obtained when the reaction is carried out in the absence of added neutral salts. This is supported by the data in Table 1 of Mattoso et al. where weight average molecular weight and number average molecular weight of polyaniline prepared with LiF (2 M) is less than the weight average molecular weight and number average molecular weight of polyaniline prepared without added neutral salt (shown in rectangular box below).

Table 1
Potential-time profiles for polyaniline for selected salts at 2 M concentration

Salt	$V_{oc}(A)$[a]	$t(A)$[b] (min)	$t(B-A)$[c] (min)	Time to reach $V_{oc} \approx 0.43$ V[d] (h)	$\bar{M}_w$	$\bar{M}_n$	$\bar{M}_w/\bar{M}_n$
No salt	0.75	5.8	4.1	1.5	53000	25000	2.08
LiF (2 M)	0.72	5.3	2.8	2.0	36900	15700	2.36
NaCl (2 M)	0.76	4.5	8.5	2.5	82500	30000	2.75
$CaCl_2$ (2 M)	0.76	4.0	7.6	3.0	100400	34400	2.92
LiCl (2 M)	0.77	5.6	9.0	3.0	121300	41400	2.93
Agar	0.67	110.0	3.9	3.0	40900	26900	1.52

[a] $V_{oc}(A)$ = maximum open circuit potential (V vs. SCE); i.e. point A in Fig. 1.
[b] $t(A)$ = time required to reach $V_{oc}(A)$.
[c] $t(B-A)$ = time required for the V_{oc} to fall from point A to point B in Fig. 1.
[d] V vs. SCE.

On page 11 of the Final Action, the Examiner states as follows:

> The MW is further increased by lowering the reaction temperature even LiF is used. Even using LiF, the resultant MW can be 36.9k (Ttable 1), within the range of claims 8 and 25.

In this regard, Applicants note that Mattoso et al. states as follows regarding reaction temperature on page 2:

> The temperature remained between 0 and 3 °C throughout the entire polymerization reaction.

Mattoso et al. also states as follows regarding reaction temperature on page 8:

> The molecular weight is further increased by lowering the temperature of the reaction system to −35 to −40 °C, the presence of the dissolved salts inhibiting the freezing of the aqueous solution at these temperatures.

Mattoso et al. recites that molecular weight is further increased by lowering temperature; however, this is different from the preparation of boronic acid substituted polyaniline polymer having a molecular weight of at least 100,000 using a saccharide and fluoride during polymerization. The boronic acid substituted polyaniline polymer having a molecular weight of at least 100,000 of the present application can also be prepared at ambient temperatures.

Furthermore, Applicants note that Claim 1 has been amended so that the boronic acid substituted polyaniline polymer has a molecular weight of at least 100,000 which is greater than the resultant MW of 36.9k identified by the Examiner in Table 1 of Mattoso et al.

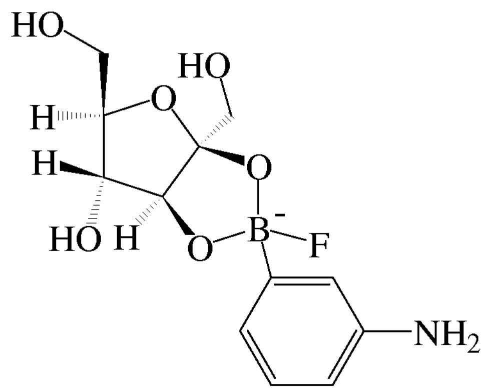
Thus, in view of the above differences, Applicants respectfully submit that the second of the three *Graham* factual inquiries strongly supports a finding of non-obviousness of amended Claim 1. Applicants further submit that neither the first nor the third of the *Graham* factual inquiries detracts from a finding of non-obviousness in the present application.

In view of the foregoing, Applicants submit that amended Claim 1 is not unpatentable over Shoji et al. in view of Mattoso et al. Claim 20 depends directly on amended Claim 1. Accordingly, withdrawal of the rejection of Claim 20 based on Shoji et al. in view of

Mattoso et al. is respectfully requested.

Amended Claim 6 recites: A polyaniline polymer capable of converting in solution between:

a water-soluble self-doped form comprising repeating units as shown below:



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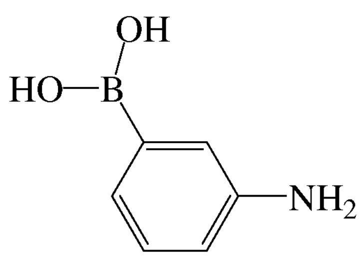
; and

a water-insoluble non-self-doped form comprising repeating units as shown below:



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wherein the polyaniline polymer has a molecular weight of at least 100,000, and wherein the water-soluble form is converted in solution to the water-insoluble form by reducing fluoride and/or fructose concentration of the polymer solution and the water-insoluble form is converted to the water-soluble form by increasing fluoride and/or fructose concentration of the polymer solution.

Applicants submit that Shoji et al. does not teach or suggest a polyaniline polymer capable of converting in solution between a water-soluble self-doped form comprising repeating units 2 and a water-insoluble non-self doped form comprising repeating units 1. In

addition, Shoji et al. does not teach or suggest that conversion to the water-insoluble form is by reducing fluoride and/or fructose concentration of the polymer solution and conversion to the water-soluble form is by increasing fluoride and/or fructose concentration of the polymer solution. Shoji et al. also does not teach or suggest that the polyaniline polymer has a molecular weight of at least 100,000.

Applicants submit that Mattoso et al. does not teach or suggest a polyaniline polymer capable of converting in solution between a water-soluble self-doped form comprising repeating units 2 and a water-insoluble non-self doped form comprising repeating units 1. In addition, Mattoso et al. does not teach or suggest that conversion to the water-insoluble form is by reducing fluoride and/or fructose concentration of the polymer solution and conversion to the water-soluble form is by increasing fluoride and/or fructose concentration of the polymer solution. Mattoso et al. also does not teach or suggest that the polyaniline polymer has a molecular weight of at least 100,000.

Applicants submit that it would not have been obvious to one of ordinary skill in the art to have modified the polyaniline disclosed by Shoji et al. and increased MW to the claimed ranges in view of Mattoso et al. because Mattoso et al. does not teach or suggest how Shoji et al. might be modified to prepare the polyaniline polymer capable of converting in solution between a water-soluble self-doped form comprising repeating units 2 and a water-insoluble non-self doped form comprising repeating units 1 that has a molecular weight of at least 100,000, as recited in amended Claim 6. There is no reasonable probability of success in preparing the polyaniline polymer of Claim 6 based on Shoji et al. in view of Mattoso et al.

For example, Mattoso et al. does not describe the preparation of a polyaniline polymer comprising repeating units 2 or repeating units 1. In contrast, Mattoso et al. describes the preparation of polyaniline and poly(*o*-methoxyaniline).

Furthermore, neither Shoji et al. nor Mattoso et al. teach or suggest the polymerization of a polyaniline polymer comprising repeating units 2 or repeating units 1 in the presence of both fructose and fluoride. Use of both fructose and fluoride during polymerization allows for the preparation of the polyaniline polymer having a molecular

weight of at least 100,000.

Applicants respectfully disagree with the Examiner's interpretation of Mattoso et al. that using LiF increases the MW of polymer produced. In contrast, using LiF did not increase the MW of the polymer produced as described in Mattoso et al. Using dissolved LiF decreases the molecular weight [of the polymer produced] as compared to the polymer obtained when the reaction is carried out in the absence of added neutral salts. This is supported by the data in Table 1 of Mattoso et al. where weight average molecular weight and number average molecular weight of polyaniline prepared with LiF (2 M) is less than the weight average molecular weight and number average molecular weight of polyaniline prepared without added neutral salt.

Mattoso et al. recites that molecular weight is further increased by lowering temperature; however, this is different from the preparation of boronic acid substituted polyaniline polymer having a molecular weight of at least 100,000 using fructose and fluoride during polymerization. The boronic acid substituted polyaniline polymer having a molecular weight of at least 100,000 of the present application can also be prepared at ambient temperatures.

Furthermore, Applicants note that Claim 6 has been amended so that the polyaniline polymer has a molecular weight of at least 100,000 which is greater than the resultant MW of 36.9k identified by the Examiner in Table 1 of Mattoso et al.

Thus in view of the above differences, Applicants respectfully submit that the second of the three *Graham* factual inquiries strongly supports a finding of non-obviousness of Claim 6. Applicants further submit that neither the first nor the third of the *Graham* factual inquiries detracts from a finding of non-obviousness in the present application.

In view of the foregoing, Applicant submits that Claim 6 is not unpatentable over Shoji et al. in view of Matttoso et al. Claim 26 depends directly on Claim 6. Accordingly, withdrawal of the rejection of Claim 26 based on Shoji et al. in view of Mattoso et al. is respectfully requested.

<u>Rejection Under 35 U.S.C. § 103(a) based on Freund et al. in view of Mattoso et al.</u>

The Examiner rejected Claims 3-4, 8-9, 20, and 25-26 as being unpatentable over Freund et al. (US 2002/0029979) in view of Mattoso et al. (Synthetic Metals, 68 (1994), 1-11). Applicant notes that Claims 3, 4, 8, 9, and 25 have been canceled. This renders moot the Examiner's rejection of Claims 3, 4, 8, 9, and 25 based on Freund et al. in view of Mattoso et al. Applicants respectfully submit that Claims 20 and 26 are not unpatentable over Freund et al. in view of Mattoso et al. for the reasons set out below.

Applicants submit that the Freund et al. and Mattoso et al. references fail to satisfy the requirements for a finding of obviousness of amended independent Claim 1 and amended independent Claim 6.

As discussed above, the Guidelines confirm that obviousness is a question of law based on underlying factual inquiries. The factual inquiries enunciated by the Court in *Graham* are as follows:

(1) Determining the scope and content of the prior art;

(2) Ascertaining the differences between the claimed invention and the prior art; and

(3) Resolving the level of ordinary skill in the pertinent art.

With respect to the second of the *Graham* factual inquiries, Applicants submit that important differences exist between the claimed invention and the Freund et al. and Mattoso et al. references.

Amended Claim 1 recites: A conductive boronic acid substituted polyaniline polymer capable of converting in solution between a water-soluble self-doped form and a water-insoluble non-self doped form, wherein conversion between the water-insoluble non-self-doped form and the water-soluble self-doped form is by a reversible chemical reaction that comprises complexation between boronic acid of the polyaniline polymer with a saccharide

in the presence of fluoride, and wherein the polyaniline polymer has a molecular weight of at least 100,000.

Applicants submit that Freund et al. does not teach or suggest a boronic acid substituted polyaniline polymer capable of converting in solution between a water-soluble self-doped form and a water-insoluble non-self doped form. In addition, Freund et al. does not teach or suggest that conversion is by a reversible chemical reaction that comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride. Freund et al. also does not teach or suggest that the boronic acid substituted polyaniline polymer has a molecular weight of at least 100,000.

As discussed above, Applicants submit that Mattoso et al. does not teach or suggest a boronic acid substituted polyaniline polymer capable of converting in solution between a water-soluble self-doped form and a water-insoluble non-self doped form. In addition, Mattoso et al. does not teach or suggest that conversion is by a reversible chemical reaction that comprises complexation between boronic acid of the polyaniline polymer with a saccharide in the presence of fluoride. Mattoso et al. also does not teach or suggest that the boronic acid substituted polyaniline polymer has a molecular weight of at least 100,000.

Applicants submit that it would not have been obvious to one of ordinary skill in the art to have modified the polyaniline disclosed by Freund et al. and increased MW to the claimed ranges in view of Mattoso et al. because Mattoso et al. does not teach or suggest how Freund et al. might be modified to prepare the boronic acid substituted polyaniline polymer capable of converting in solution between a water-soluble self-doped form and a water-insoluble non-self doped form that has a molecular weight of at least 100,000, as recited in amended Claim 1. There is no reasonable probability of success in preparing the boronic acid substituted polyaniline polymer of Claim 1 based on Freund et al. in view of Mattoso et al.

For example, Mattoso et al. does not describe the preparation of a <u>boronic acid substituted</u> polyaniline polymer as recited in Claim 1. In contrast, Mattoso et al. describes the preparation of polyaniline and poly(*o*-methoxyaniline). Furthermore, neither Freund et al. nor Mattoso et al. teach or suggest the polymerization of boronic acid substituted

polyaniline in the presence of both a saccharide and fluoride. Use of both a saccharide and fluoride during polymerization allows for the preparation of boronic acid substituted polyaniline having a molecular weight of at least 100,000.

Applicants respectfully disagree with the Examiner's interpretation of Mattoso et al. that using LiF increases the MW of polymer produced. In contrast, using LiF did not increase the MW of the polymer produced as described in Mattoso et al. Using dissolved LiF decreases the molecular weight [of the polymer produced] as compared to the polymer obtained when the reaction is carried out in the absence of added neutral salts as supported by the data in Table 1 of Mattoso et al. where weight average molecular weight and number average molecular weight of polyaniline prepared with LiF (2 M) is less than the weight average molecular weight and number average molecular weight of polyaniline prepared without added neutral salt.

As discussed above, Mattoso et al. recites that molecular weight is further increased by lowering temperature; however, this is different from the preparation of boronic acid substituted polyaniline polymer having a molecular weight of at least 100,000 using a saccharide and fluoride during polymerization. The boronic acid substituted polyaniline polymer having a molecular weight of at least 100,000 of the present application can also be prepared at ambient temperatures.

Furthermore, Applicants note that Claim 1 has been amended so that the boronic acid substituted polyaniline polymer has a molecular weight of at least 100,000 which is greater than the resultant MW of 36.9k identified by the Examiner in Table 1 of Mattoso et al.

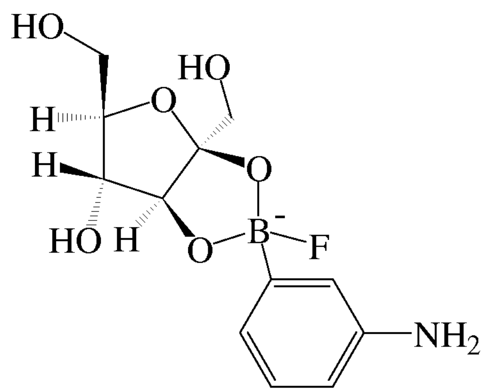
Thus, in view of the above differences, Applicants respectfully submit that the second of the three *Graham* factual inquiries strongly supports a finding of non-obviousness of amended Claim 1. Applicants further submit that neither the first nor the third of the *Graham* factual inquiries detracts from a finding of non-obviousness in the present application.

In view of the foregoing, Applicants submit that amended Claim 1 is not unpatentable over Freund et al. in view of Mattoso et al. Claim 20 depends directly on amended Claim 1. Accordingly, withdrawal of the rejection of Claim 20 based on Freund et al. in view of

Mattoso et al. is respectfully requested.

Amended Claim 6 recites: A polyaniline polymer capable of converting in solution between:

a water-soluble self-doped form comprising repeating units as shown below:



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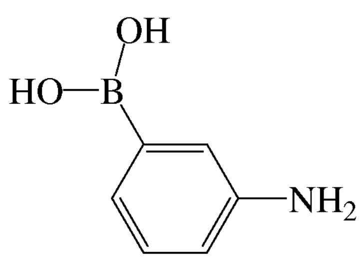
; and

a water-insoluble non-self-doped form comprising repeating units as shown below:



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wherein the polyaniline polymer has a molecular weight of at least 100,000, and wherein the water-soluble form is converted in solution to the water-insoluble form by reducing fluoride and/or fructose concentration of the polymer solution and the water-insoluble form is converted to the water-soluble form by increasing fluoride and/or fructose concentration of the polymer solution.

Applicants submit that Freund et al. does not teach or suggest a polyaniline polymer

capable of converting in solution between a water-soluble self-doped form comprising repeating units 2 and a water-insoluble non-self doped form comprising repeating units 1. In addition, Freund et al. does not teach or suggest that conversion to the water-insoluble form is by reducing fluoride and/or fructose concentration of the polymer solution and conversion to the water-soluble form is by increasing fluoride and/or fructose concentration of the polymer solution. Freund et al. also does not teach or suggest that the polyaniline polymer has a molecular weight of at least 100,000.

Applicants submit that Mattoso et al. does not teach or suggest a polyaniline polymer capable of converting in solution between a water-soluble self-doped form comprising repeating units 2 and a water-insoluble non-self doped form comprising repeating units 1. In addition, Mattoso et al. does not teach or suggest that conversion to the water-insoluble form is by reducing fluoride and/or fructose concentration of the polymer solution and conversion to the water-soluble form is by increasing fluoride and/or fructose concentration of the polymer solution. Mattoso et al. also does not teach or suggest that the polyaniline polymer has a molecular weight of at least 100,000.

Applicants submit that it would not have been obvious to one of ordinary skill in the art to have modified the polyaniline disclosed by Freund et al. and increased MW to the claimed ranges in view of Mattoso et al. because Mattoso et al. does not teach or suggest how Freund et al. might be modified to prepare the polyaniline polymer capable of converting in solution between a water-soluble self-doped form comprising repeating units 2 and a water-insoluble non-self doped form comprising repeating units 1 that has a molecular weight of at least 100,000, as recited in amended Claim 6. There is no reasonable probability of success in preparing the polyaniline polymer of Claim 6 based on Freund et al. in view of Mattoso et al.

For example, Mattoso et al. does not describe the preparation of a polyaniline polymer comprising repeating units 2 or repeating units 1. In contrast, Mattoso et al. describes the preparation of polyaniline and poly(*o*-methoxyaniline).

Furthermore, neither Freund et al. nor Mattoso et al. teach or suggest the polymerization a polyaniline polymer comprising repeating units 2 or repeating units 1 in the

presence of both fructose and fluoride. Use of both fructose and fluoride during polymerization allows for the preparation of the polyaniline polymer having a molecular weight of at least 100,000.

Applicants respectfully disagree with the Examiner's interpretation of Mattoso et al. that using LiF increases the MW of polymer produced. In contrast, using LiF did not increase the MW of the polymer produced as described in Mattoso et al. Using dissolved LiF decreases the molecular weight [of the polymer produced] as compared to the polymer obtained when the reaction is carried out in the absence of added neutral salts. This is supported by the data in Table 1 of Mattoso et al. where weight average molecular weight and number average molecular weight of polyaniline prepared with LiF (2 M) is less than the weight average molecular weight and number average molecular weight of polyaniline prepared without added neutral salt.

Mattoso et al. recites that molecular weight is further increased by lowering temperature; however, this is different from the preparation of boronic acid substituted polyaniline polymer having a molecular weight of at least 100,000 using fructose and fluoride during polymerization. The boronic acid substituted polyaniline polymer having a molecular weight of at least 100,000 of the present application can also be prepared at ambient temperatures.

Furthermore, Applicants note that Claim 6 has been amended so that the polyaniline polymer has a molecular weight of at least 100,000 which is greater than the resultant MW of 36.9k identified by the Examiner in Table 1 of Mattoso et al.

Thus, in view of the above differences, Applicants respectfully submit that the second of the three *Graham* factual inquiries strongly supports a finding of non-obviousness of Claim 6. Applicants further submit that neither the first nor the third of the *Graham* factual inquiries detracts from a finding of non-obviousness in the present application.

In view of the foregoing, Applicants submit that Claim 6 is not unpatentable over Freund et al. in view of Mattoso et al. Claim 26 depends directly on Claim 6. Accordingly, withdrawal of the rejection of Claim 26 based on Freund et al. in view of Mattoso et al. is respectfully requested.

An earnest effort has been made to place this application in condition for allowance which action is respectfully solicited. Should the Examiner have any questions regarding the allowability of the claims with respect to the art, it would be appreciated if the Examiner would contact the undersigned attorney-of-record at the telephone number shown below for further expediting the prosecution of the application.

Any deficiencies in additional claim fees, extension of time fees or for the accompanying Request for Continued Examination may be charged to

Deposit Account 04-1577.

Respectfully Submitted;

/Ralph A Dowell/

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Date: 02/16/2011

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